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Agricultural Research

Trouble on the Range

Story on page 6

Research Would Boost Farm Profits, Exports

Current plans of the Agricultural Research Service call for taking aggressive new approaches to bolstering U.S. farm income and exports. Agency research from 1986 through 1992 will play an expanding part in combating the decline in farm income and exports. These are two of the most critical problems facing our country today.

We believe that a significant enhancement of farm income could result from development of new, commercial products made from surplus farm commodities. Also, research can improve the quality and acceptability of many U.S. farm commodities, making them more competitive in markets here and overseas.

In addition to these goals, the latest 6-year ARS research implementation plan directs scientists to make greater efforts to solve a number of national problems by:

- Increasing the number of interdisciplinary teams of scientists to encourage more innovation: A recent example of this team concept is the research group set up at the ARS Southern Regional Research Center in New Orleans to work on improving cotton fiber. In conducting this research, microbiologists and genetic engineers are working more closely than ever with traditional plant breeders to produce a higher quality cotton that can be more competitive with other fibers.
- Expanding plant germplasm programs: Since the turn of the century, thousands of crop plant varieties have been lost because they were not being used and propagated. To make sure that remaining germplasm is available to plant breeders in the future, we will strengthen a national system to collect, maintain, and distribute seeds and plant tissue. The ability to manipulate the genetic material within plant cells will be expanded as a prerequisite to developing more efficient crops and animals. A Plant Gene Expression Center in Albany, CA, is being opened to develop new genetic research techniques. In Maryland, a new biotechnology research center is planned in cooperation with the University of Maryland.
- Keeping pollutants out of groundwater: We are developing new and improved technology for preventing or reducing groundwater contamination by agricultural chemicals. This includes refinement of computer models to predict more accurately water movement down through the root zone as well as across the surface of the land.
- Conserving soil and water resources: We are developing new technology to control salinity and toxic elements in irrigation and drainage waters in the West. Another strategy with important implications in areas where water supplies are declining—such as the Great Plains' Ogallala aquifer—is helping farmers adapt to dryland conditions. Cotton plants with smaller leaves and denser rooting systems are one example.
- Fostering the use and development of computer-based information and data management systems in ARS: We will make increasing use of expert systems to transfer technology from scientists to users. These computer-based information systems will help farmers improve efficiency and increase profits. A 2-year pilot test of an expert system for cotton growers has shown that farm income can be increased by thousands of dollars per grower if the system's recommendations are followed.
- Reducing storage and processing costs of farm products: Mounting stocks of feed grains, for example, could be reduced by finding new industrial markets for starch. We're looking for ways to turn that starch into plastics, enzymes, soil conditioners, and chemical feedstocks. Other components of grain, such as proteins and vegetable oils, also have potential for making products such as paint and varnish.
- And protecting the quality, nutrition, and safety of America's food supply: We are searching for a more complete understanding of the relationships between nutrition and optimal health, with special attention to the problems of infants and children, mothers, and the elderly.

Problems facing agriculture constantly change and are increasingly complex, as is the research needed to solve them. Our latest plan outlines new strategies to help us cope with these complexities in the years ahead.—**Terry B. Kinney, Jr.,** Administrator

[Single copies of Agricultural Research Service Program Plan, 6-Year Implementation Plan, 1986-1992, are available from the Publications Branch, ARS Information Staff, B-005, BARC-West, Beltsville, MD 20705.]

Agricultural Research

COVER: Plants poisonous to livestock are found on all types of forage land, from high mountain range to lush meadow to arid plain. Animal physiologist A. Earl Johnson searches southern Arizona high country for threadleaf groundsel, one of many poisonous plants under study at the ARS Poisonous Plant Research Laboratory, Logan, UT. Story begins on page 6. (0386X459-33)

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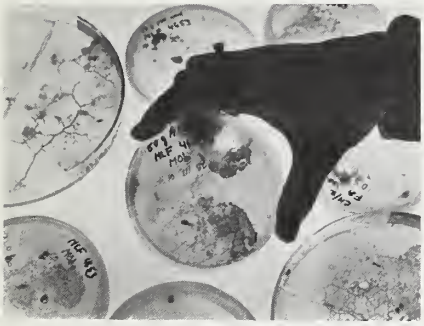

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Taste Survey Rates Sweet Sandwich Mild

Onion lovers, get ready to crunch a new onion hybrid that's already wowed people in New York State.

In a 1984 survey, New Yorkers thought Sweet Sandwich more mild than Yellow Globe cooking onions by a margin of 78 percent. The new onion got its name because its mild taste and smell make it ideal for sandwiches and salads, says Clinton E. Peterson, a horticulturist with the Agricultural Research Service at the University of Wisconsin in Madison.

Home gardeners throughout the country can conduct their own taste tests this summer because Sweet Sandwich bulbs, seeds, and plants made their commercial debut in this year's seed catalogs.

The hybrid was released in 1982 by the U.S. Department of Agriculture and New York and Michigan Agricultural Experiment Stations. Commercial seed production began the following season.

In 1984 field tests in New York, Sweet Sandwich yields surpassed or equaled those of the most popular onion variety in the state. It also produced the large size preferred for mild onions.

Peterson also directed the breeding and testing of a sweet cucumber, the first truly resistant to a very destructive disease called bacterial wilt.

Besides being almost immune to the disease, the cucumber, County Fair 83, has the added advantage of not turning bitter even under severe stress caused by disease, drought, or inadequate soil nutrients.

County Fair 83 is ideal for home gardens, says Peterson, "Its mild flavor makes for better tasting salads and homemade pickles." These seedless cucumbers are slow maturing and don't lose color and soften on the vine as quickly as normal seed-producing varieties.

They are also resistant to scab, cucumber mosaic virus, powdery mildew, downy mildew, anthracnose, angular leaf spot, and fusarium wilt.

County Fair 83 has been tested successfully for several years in Wisconsin and Nebraska. Plant pathologist James R. Steadman and other University of Nebraska scientists worked with Peterson and ARS scientists to develop the new hybrid.

Peterson provided seed samples to home gardeners in widely scattered areas of the country. Their reports indicate the hybrid seems likely to become a popular cucumber.—By **Linda Cooke-Stinson** and **Ben Hardin,** ARS.

Clinton E. Peterson is in USDA-ARS Vegetable and Forage Research at the University of Wisconsin, Horticulture Department, 1575 Linden Drive, Madison, WI 53706. ■

Dwarfed Sunflowers Easier To Harvest

Sunflowers are more likely to hold their heads up for harvesting if their stalks have been dwarfed by a herbicide intended to kill wild oats, says Jeffrey C. Suttle of the Agricultural Research Service. Normal-height plants tend to topple during windy, wet weather, particularly when the heads become heavy with ripening seeds.

Suttle, a plant physiologist in Fargo, ND, has found that the herbicide difenzoquat temporarily slows cell division in young sunflower stalks. Sunflower seedlings sprayed with this chemical grew only two-thirds as tall as untreated plants but matured normally otherwise.

"The growth-regulating properties of difenzoquat are not surprising," Suttle says, "when one realizes that several currently registered agricultural chemicals now used as bioregulators were initially used as herbicides." He cautions, however, that difenzoquat is not approved for growth regulation on sunflowers.

Planted at the same time, sunflower on right was treated with difenzoquat 6 days after emerging, causing reduced stem growth. Sunflower on left was untreated. (PN-7203)

Examples of dual-purpose chemicals in use include glyphosate, used as a sugarcane ripener; mefluidide, used to retard turfgrass; and 2,4-D, used as a hormone supplement in plant tissue culture.—By **Linda Cooke-Stinson,** ARS.

Jeffrey C. Suttle is at the USDA-ARS Metabolism and Radiation Research Laboratory, State University Station, P.O. Box 5674, Fargo, ND 58105. ■

Variety Is More Than Spice of Life

Of the approximately 8,000 apple varieties known in 1905, all

but about 1,200 have been lost. A similar tale could be told for grapes, with the losses continuing today. When a variety is lost, so too are the gene combinations people spent years breeding. Even worse, it means the lost variety's genes—along with their unknown qualities—are likely to be found only in wild plants that could become extinct.

To save the genes of apple and grape varieties and their wild ancestors in North America and the Middle East, the Agricultural Research Service and the New York State Agricultural Experiment Station in Geneva, NY, recently opened the National Clonal Germplasm Repository for Apples and American Grapes.

The repository is fittingly located in the heart of the Finger Lakes region, the center of New York State's thriving fruit industry. New York ranks second in the United States in production of both apples and grapes.

Special facilities are needed to preserve the germplasm (genes and other hereditary materials) of plants that are clonally propagated. This is because the gene combinations that characterize each apple or grape variety are not transmitted faithfully through their seeds. They must be propagated from cuttings or grafts, requiring the storage of living plants or tissue rather than seeds.

The $1 million repository at Geneva covers 8,000 square feet including greenhouses, laboratories, office space, and other facilities. It will maintain both wild and domesticated apples and grapes in the greenhouses and on about 50 acres of orchards and vineyards.

Scientists at the repository will study and catalog the plant varieties for characteristics such as resistance to insects and disease. The repository will share its plant materials with breeders and other researchers in this country, as well as those in countries that have reciprocal exchange programs.

Philip L. Forsline, curator of the new clonal repository at Geneva, says the Geneva Station was chosen for the repository because it has a 104-year history of maintaining and breeding an extensive collection of fruit germplasm.

The repository shares space with the ARS Northeast Plant Introduction Station, which was set up in the early 1900's to maintain germplasm for vegetables, forage grasses, and some ornamentals.—By **Don Comis,** ARS.

Philip L. Forsline, a USDA-ARS horticulturist, is the curator of the National Clonal Germplasm Repository, New York State Agricultural Experiment Station, Geneva, New York 14456. ■

Soaked Seeds Grow Poorly

Contrary to popular belief, soaking seeds to get them off to a fast start may actually do more harm than good. Normally, when a seed is planted, it takes up water from the soil and forms a root tip, which pokes a tiny hole in the seed cover. Thus, the developing plant is free to expand and grow.

However, if the seed is soaked or the ground is too wet, the seed takes up water too quickly, and its cover cracks. These fractures allow whatever is inside—amino acids, proteins, and sugars—to leak into the surrounding soil.

At that point, disease-causing soil fungi—nourished by the leaking seed—begin to infect the young, highly susceptible seedling.

Leakage is a big problem with grain and legume crops, not because of presoaking, but because they may be sown in wet soil or rains may come soon after planting. These plants never completely recover, says plant physiologist Stephen C. Spaeth with the Agricultural Research Service in Pullman, WA.

Cracks in bean cotyledon after soaking in water. (PN-7205)

Using a stress measuring instrument he designed, Spaeth studied fracturing characteristics of many kinds of seeds. He found that the cotyledons—seed parts that supply young seedlings with food—elongate very slowly as stress builds and the seed is stretched. As moisture builds up, the cotyledon cracks—much like the cracking one sees and hears when an ice cube is dropped into a warm drink.

Two methods are available to farmers now to reduce seed fracturing. One is to delay planting to avoid the moist field conditions that promote fracturing. But this practice shortens growing time and can reduce crop yields.

The other way to prevent fracturing is to place the seeds in a special moisture-controlled room to gradually raise their water content before planting. But for large-scale agriculture, this technique is costly.

A new, less expensive method, still at the experimental stage, looks promising, says Spaeth. It involves coating seeds with a waxy compound that slows water uptake and prevents fracturing.—By **Howard Sherman,** ARS.

Stephen C. Spaeth is in USDA-ARS Grain and Legume Genetics and Physiology Research, Johnson Hall, Washington State University, Pullman, WA 99164. ■

Grazing Poisonous Plants

Above: Chemist Richard Keeler inspects a steer suffering from "crooked calf disease" induced when the pregnant mother ate lupine, a poisonous plant, between the 40th and 70th days after breeding. The condition is usually characterized by deformed front limbs and curvature of the spine or neck. (0386X461-24)

Top, right: Ingestion of false hellebore by pregnant sheep on day 14 of gestation causes severe facial deformities as these top three skulls attest. The bottom skull is from a normal animal. (0386X466-4A)

Just after sunrise one clear day in January 1971, sheep herders near Garrison, UT, awoke to a grisly sight. More than 1,200 ewes lay dead—scattered about the gently sloping hillside where they had bedded down the night before.

Within hours, scientists with the Agricultural Research Service were at the scene inspecting the area, taking photographs, and collecting tissue samples from the dead sheep for analysis. A few days later, their laboratory tests determined what they had immediately suspected. The sheep had eaten leaves containing oxalates, the principal poisonous compound of halogeton, a fast-growing annual weed.

The scientists learned from the foreman of the sheep herders that the day before the ewes died, he had guided the flock through about 20 acres of range heavily infested with halogeton. He knew the plants were poisonous, so he moved the sheep away from the deadly plants to a place about half a mile away where he felt they would be safe for the night.

According to one scientist, the sheep must have awakened hungry during the night and wandered back to the halogeton-infested site. "Those plants were about one-third pure poison," he says. "It probably took only a quarter pound of leaves to kill the ewes, maybe 3 or 4 mouthfuls. The sheep must have died within 4 hours."

"Each year, livestock losses related to poisoning cost ranchers in the western states more than $190 million."
—Lynn F. James

This type of scenario is replayed a number of times a year throughout the West, although the results are usually not as severe.

To help prevent these losses, seven ARS scientists make research into the effects of poisonous plants on livestock the top priority at the ARS Poisonous Plant Research Laboratory—the only one of its kind in the world.

At any one time, scientists at Logan, UT, are studying 15 or 20 plant species that can cause a range of disorders from birth defects to death.

The scientists' job is to identify specific toxins in poisonous plants, describe symptoms of poisoning, and develop new methods for cutting livestock losses from poisoning.

"Each year, losses related to poisoning affect 3 to 5 percent of the cattle, sheep, and horses that graze western ranges and cost ranchers in those states more than $190 million," says lab director Lynn F. James. "The West abounds with shrubs, grasses, and trees that can cripple, kill, cause abortion, and in many other ways interfere with livestock production. And while humans can choose to avoid poisonous plants, animals often cannot."

"Halogeton is a good example of a bad plant," says M. Coburn Williams, plant physiologist at the laboratory. It was discovered near Wells, NV, shortly after it found its way into this country from Asia in the early 1930's and now infests over 12 million acres of desert range in at least seven western states.

The trouble with an undesirable, fast-growing plant like halogeton, is that by the time it is recognized as a problem, it may be well established. Controlling these plants is extremely difficult and costly, if not impossible, given the vast spaces involved and the difficulty in reaching them.

Research by James shows that sheep can safely graze small amounts of halogeton without apparent harm because bacteria in their stomachs can break down limited amounts of oxalate, making it harmless. But hungry sheep allowed to graze heavy growths of halogeton in a short period can be fatally poisoned.

The solution? "Make sure the sheep are well fed and watered before moving them through range infested with halogeton," James says.

As a direct result of James' studies, ranchers have devised management plans that have cut their livestock losses due to halogeton in half.

What other advice does James have for ranchers?

- As soon as livestock have grazed the most desirable plants, move them from the area. (Otherwise, they will be forced to eat plants that may be poisonous.)
- Don't allow overgrazing even where poisonous plants are not present. It encourages them to invade the weakened rangeland.
- Spend more time walking around fields. Driving a pickup around isn't the best way to identify weed problems.

Poisoning the Next Generation

Chemist Richard F. Keeler's work provides another example of damage caused by poisonous plants. If pregnant ewes eat leaves of the false hellebore plant—a member of the lily family that grows in wet meadows and forests—they may have severely deformed "monkey-faced" offspring with protruding jaws and various eye defects including a single "cyclopic" eye.

Several members of the *Lupinus* genus are responsible for "crooked calf disease." The plants are recognizable by their "pea family" shaped flowers and compound leaves with multiple leaflets. (0386X467-36)

"Strangely enough," says Keeler, "our research showed that these deformities are produced only if ewes happen to eat false hellebore on the 14th day after conception."

Still further research by Keeler and colleagues revealed that eating false hellebore leaves 19 to 21 days after conception causes early embryonic death. And eating the

leaves during days 27 to 33 causes tracheal stenosis, a condition in which lambs die immediately after birth because they are born with their windpipes completely collapsed.

As horrible as the effects of eating false hellebore may be, they can be prevented with a simple management strategy. "Keep sheep away from the plant until all ewes have passed their 33rd day of pregnancy," says Keeler. That's the message that went out to sheep ranchers as a result of this research.

Keeler says the results of the sheep study at Logan agree with those of a human study by scientists at the National Institutes of Health in Bethesda, MD—namely, that cyclopomene, a toxic substance found in false hellebore, indirectly causes birth defects by inhibiting the synthesis of proteoglycan, a component necessary for cartilage development.

Keeler and co-workers are also exploring other links between plant poisons and birth defects in sheep, cattle, and pigs. He believes this type of research not only reduces problems for ranchers, but could serve as an excellent model for studying similar birth defects in humans.

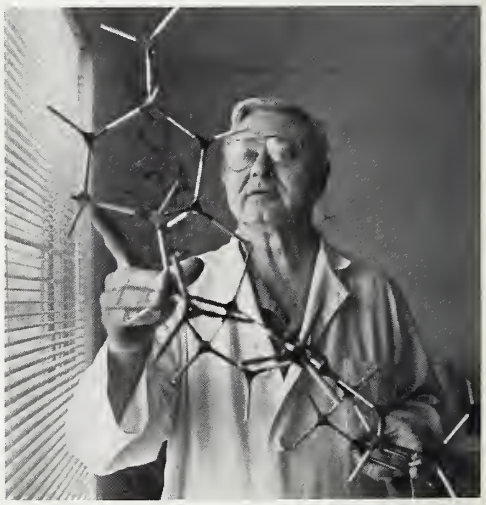
Another problem for ranchers is abortion caused when cows eat needles from ponderosa pine trees, found in all 17 western states.

Cows that graze even small amounts of pine needles during the last trimester of their pregnancy may abort and die from complications. Abortion can take place anywhere from 2 days to 2 weeks from the time the animal eats the needles, says James.

Animal scientist Kip Panter collects blood samples for hormonal and biochemical analyses of ponderosa pine needle abortion in beef cattle. (0386X460-28)

A Deadly Sunburn

Some plants cause a painful type of sunburn that can kill light-skinned animals, says animal physiologist A. Earl Johnson. These phototoxic plants contain a substance that makes skin ultrasensitive to sunlight. When animals—especially sheep—eat the plants, they absorb the phototoxic compounds, which are



New Clue to Livestock Poisonings

A previously unsuspected chemical may play a key role in causing hundreds of wild plants throughout the world to be poisonous to animals and people.

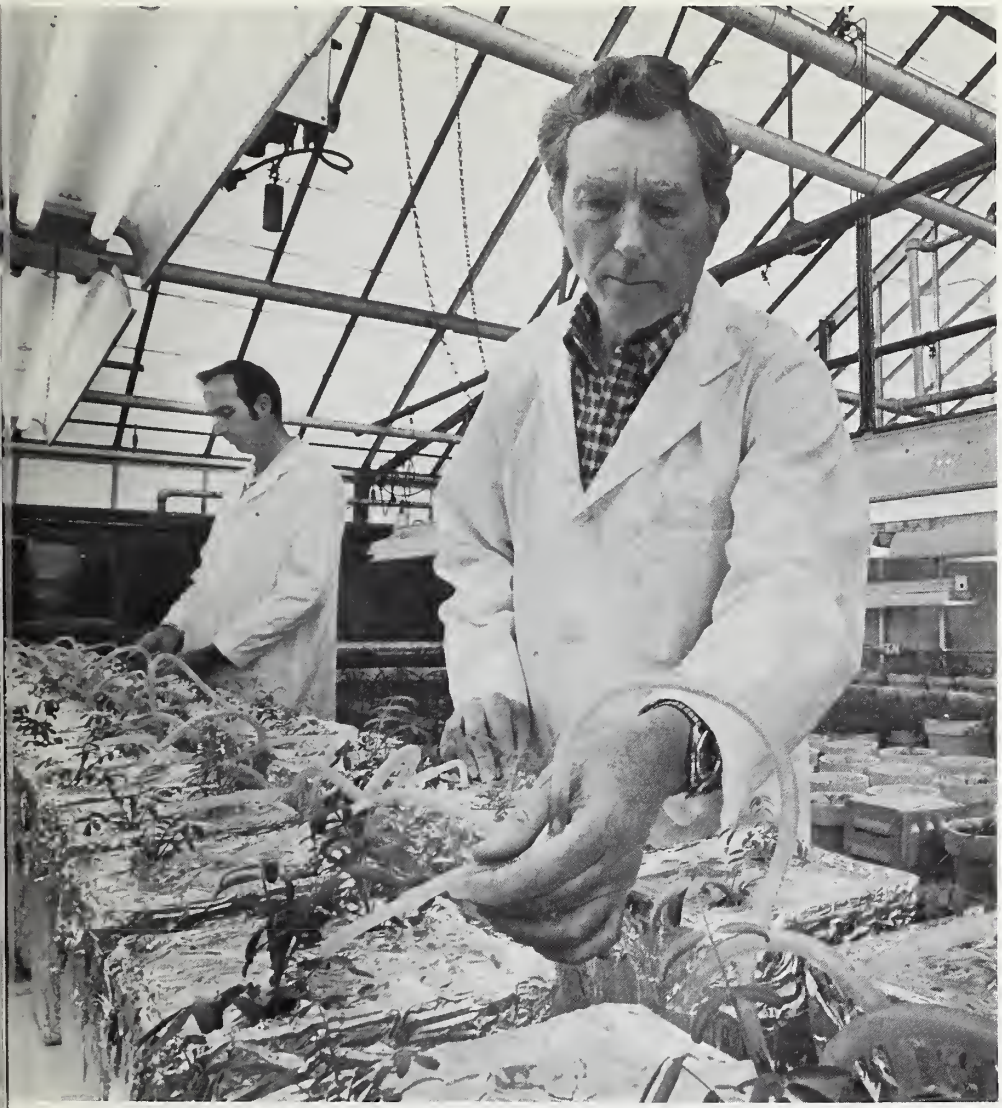
"The chemical is produced when plant compounds known as pyrrolizidine alkaloids come in contact with enzymes in the liver," says William F. Haddon, a chemist with the Agricultural Research Service in Albany, CA.

Haddon and a team of University of California at Davis researchers are the first to discover the possible role of this chemical, *trans*-4-hydroxy-2-hexenal, in plant poisonings. The university team included H.J. Segall and D.W. Wilson of the School of Veterinary Medicine, and J.L. Dallas, Department of Biological Chemistry.

Haddon says the new findings challenge previous theory, widely accepted by toxicologists and veterinary medicine researchers, which attributed the poisoning exclusively to compounds known as pyrroles.

The discovery of the role of *trans*-4-hydroxy-2-hexenal in pyrrolizidine alkaloid poisoning should help researchers develop an antidote.

Pyrrolizidine alkaloids, which occur naturally in many weeds that grow throughout the United States and other countries, kill horses, cattle, pigs, and other livestock by causing cumulative and irreversible damage to the liver. In humans, cases of pyrrolizidine alkaloid poisoning are rare. One cause of poisoning in this



Left: Keeler examines a molecular model of cyclopomene, an alkaloid compound from false hellebore. Identified by Keeler, the compound's structure and configuration are critical to birth defects caused by false hellebore. (0386X460-14)

Above: In greenhouse studies, range scientist Michael Ralphs (left) and plant physiologist M. Coburn Williams grow western wheatgrass to test for selenium levels. Many rangeland plant species, including western wheatgrass, have the ability to accumulate toxic levels of selenium which can cause infertility, loss of hair, sloughing of hooves, and death in livestock. (0386X463-15)

absorbed and circulated in the blood to the capillaries of the skin, where they are activated by the sun's rays.

This type of poisoning causes everything from abnormal redness and blistering of the skin to ulceration, gangrene, and permanent disfigurement. Animals eating these plants may also become blind and, as a result, often die of starvation and thirst.

Johnson says the horsebrush plants cause more sheep losses than all other phototoxic plants combined. Other wild plants responsible for sunburning include spring parsley, wild parsnip, and St. Johnswort.

Spring parsley, for example, thrives at the height of the lambing season before many other plants have begun to grow. Animals do not die directly from eating spring parsley, but a ewe's udder may become so inflamed and tender that she refuses to let her lamb nurse, and it starves to death.

Spring parsley is native to the West. But a large number of poisonous plants, like halogeton, got here from other countries, either purposely or through carelessness.

Beware the Late-Summer Groundsel!

Threadleaf groundsel is a native sagebrush-like plant in the sunflower family. It is one of the most common poisonous plant in the Southwest.

country has been homemade teas made with wild plants that contain these alkaloids.

The chemical is a metabolite, or byproduct. "The enzymes of the liver transform pyrrolizidine alkaloids into this toxic metabolite," Haddon says. "Normally, the liver acts as a detoxifier, secreting enzymes that reduce the toxicity of ingested material. But in the case of pyrrolizidine alkaloids, the enzymes have—tragically—the exact opposite effect."

Haddon says that the chemical structure of the newly found metabolite is "almost identical to that of a metabolite formed in livers of laboratory animals exposed to carbon tetrachloride or bromotrichloromethane, two commonly used industrial chemicals." He notes, "This parallel may give us some new insights on liver disease."

The metabolite was found during laboratory analyses of chemicals produced when a pyrrolizidine alkaloid extracted from a small flowering weed known as common groundsel *(Senecio vulgaris),* was exposed to a mixture of liver enzymes.

The researchers used three types of laboratory analyses—high performance liquid chromatography, gas chromatography, and mass spectrometry—to obtain a precise picture of the chemicals that resulted from the interaction.

The discovery was reported in *Science* magazine August 2, 1985.—By **Marcia Wood,** ARS.

William F. Haddon is at the USDA-ARS Western Regional Research Center, 800 Buchanan Street, Albany, CA 94710. ■

Johnson and Russell J. Molyneux, a chemist at the ARS Western Regional Research Center in Albany, CA, were the first to find seasonal variations in the amounts of pyrrolizidine alkaloids in threadleaf groundsel.

Pyrrolizidine alkaloids are converted into toxins by enzymes in an animal's liver. Over time, these toxins cause severe liver damage similar to the effect excessive alcohol can have on a human liver.

Lab tests by Johnson and Molyneux showed levels of the chemical are exceptionally high when the plants are in the bud and early flower stage, usually in late summer. Livestock are relatively safe from poisoning in the winter when concentrations of pyrrolizidine alkaloids in plants are low.

Groundsel, as well as halogeton, false hellebore, ponderosa pine, spring parsley, St. Johnswort, horsebrush, and many other poisonous plants are described in a full-color publication, "Plants Poisonous to Livestock in the Western States," USDA Agriculture Information Bulletin 415. While the supply lasts, single copies are available free on request to the Poisonous Plant Research Laboratory.—By **Howard Sherman,** ARS.

Lynn F. James, A. Earl Johnson, Richard F. Keeler, and M. Coburn Williams are at the USDA-ARS Poisonous Plant Research Laboratory, 1150 E. North, Utah State University, Logan, UT 84321. ■

How Do You Handle Poisonous Plants? Don't!

Although their main work is with livestock poisoning, scientists at the Poisonous Plant Research Laboratory are often called upon to lend their expertise to doctors treating human victims.

The Poison Control Center in Salt Lake City, UT—one of many U.S. centers whose personnel respond to acute emergencies by phone—refers many cases of plant poisoning to the lab, particularly when a plant must be quickly identified so doctors can treat the victim. Each year in the United States, more than 12,000 children and adults are poisoned by plants.

Scientists at the poisonous plant lab caution people that many ornamentals produce berries, nuts, beans, or fruits which are attractive to children but deadly if eaten.

Toxic plants such as dieffenbachia are better omitted as house plants if there are small children in the family. And poisonous garden plants such as foxglove, larkspur, and young rhubarb should be relegated to less accessible parts of the garden. Castorbean, which has attractive—but deadly—seeds, is better not used as an ornamental until children are old enough to understand the dangers of poisonous plants.

Oleander—widely used as an ornamental in parks, along fences, and in yards—is one of the most toxic plants known. It contains heart poisons called cardiac glycosides. People have died from eating marshmallows or hot dogs skewered on an oleander branch. And yellow oleander, aptly called the "be-still tree," is the most frequent cause of plant poisoning in Hawaii because of its use as a folk medicine.

Those faced with a plant poisoning should be prepared to describe the plant as well as the amount and part eaten. Samples of the plant should be saved. People should also be sure to follow a physician's directions for treatment. Don't assume the plant was not poisonous because there are no immediate symptoms. Toxic symptoms may not appear for several hours, and then it may be too late.—**H.S.** ■

New Chemical

Keeping yellowjackets with their threatening stingers from swarming around backyard picnic tables may someday be easier to do. An Agricultural Research Service scientist has developed a chemically baited trap to catch them.

Entomologist Jeffrey R. Aldrich lures the most menacing types of yellowjackets in the eastern United States into traps using a blend of artificial, nontoxic chemicals similar to a natural insect pheromone, or attractant. It is most effective in spring and early summer, when the sweet-smelling chemicals attract yellowjacket queens before they establish nests.

"If queens can be captured before they make nests, then they can either be killed or moved so they establish colonies in woods, fields, and other areas away from people," says Aldrich, who works at the ARS research center in Beltsville, MD. "The traps can also be used in late summer and fall to catch yellowjacket workers after a colony has started."

Some species of yellowjackets are a nuisance to people, but they also play a valuable role as predators, feeding on flies, caterpillars, and other insects.

"It's hard to convince people who have been stung by yellowjackets that they are beneficial insects, but they are," says Aldrich. "Yellowjackets prey on other insects and do a small amount of pollinating."

Aldrich says his chemicals and

Bait Lures Yellowjackets

Top, left: Eastern yellowjacket queen. (0684W751-4)

Above: To lure yellowjackets, entomologist Jeffrey Aldrich loads insect trap with a chemical attractant. (0386X427-27)

trap work particularly well against the eastern and German yellowjackets, among the most menacing types in the eastern United States. Other attractants have worked against the western yellowjacket but have been ineffective against yellowjacket species in eastern North America.

In field tests, Aldrich used several types of traps hung at shoulder height on tree branches along borders of woods and pasture areas. The chemicals inside are either a sticky liquid or part of a small plastic pellet.

Aldrich caught queens from two of the most pesky species—the eastern and German yellowjackets. He says the chemicals are better than current attractants, which include cat and dog food. His baited traps will be most effective in urban and suburban areas, he says, where there are fewer queens.

Aldrich's chemical blend has the same major ingredients that are in a pheromone from a predatory insect called the spined soldier bug. (See Patents, p. 16, this issue.) While testing artificial attractants for this member of the stink bug family, Aldrich found that certain types of yellowjackets were also attracted to the bug's pheromone. He is not sure exactly why, but he has two theories.

One is that the yellowjacket responds to the pheromone because it wants to steal the stink bug's prey. The other is that yellowjackets are drawn to the pheromone because it smells like chewed tree leaves, where yellowjackets often find insects on which to feed.

The eastern and German yellowjackets eat other insects but also scavenge in garbage and at picnic tables for food and, if disturbed, can sting humans. They are particularly threatening because they can nest in buildings as well as underground and because their colonies are large—up to 4,000 or 5,000 to a colony. Also, yellowjackets, unlike honey bees, can sting repeatedly and stay alive.

"The one or two yellowjackets that may sting you during a barbecue or in your backyard, for example, will not seriously hurt you, unless you are allergic to their venom," Aldrich says.

"But if a child stepped on an underground nest, or if you ran over a nest with the lawnmower, that could be a life-threatening situation. Having a few hundred yellowjackets coming after you is dangerous."

One advantage of his method, Aldrich says, is that the chemical pheromone only attracts yellowjackets that are about 3 feet away from the trap. That means once yellowjackets in the immediate area are caught, others from farther away won't be drawn to it.

Aldrich has been field-testing the chemicals at Beltsville over the last several years, seeking a chemical blend that not only catches yellowjackets but that does not harm honey bees. He says honey bees are generally not strongly attracted to the chemicals.—By **Sean Adams,** ARS.

Jeffrey R. Aldrich is at the USDA-ARS Insect and Nematode Hormone Laboratory, Bldg. 467, BARC-East, Beltsville, MD 20705. ■

Molds, Mildew, and More

Late one Sunday night in August 1985, a 2-year-old child was rushed to the Washington, DC, Children's Hospital after having eaten a mushroom believed to be poisonous.

Since the mushroom had not been identified, physicians were unsure of how to best treat the child. They put in an emergency call to fungus specialist David F. Farr, co-curator of the Agricultural Research Service's National Fungus Collections (NFC), at his home.

By 1:00 a.m., a portion of the mushroom had been flown by helicopter to the ARS Systematic Botany, Mycology, and Nematology Laboratory in Beltsville, MD, where the Collections are kept.

Farr immediately began his identification—cutting off the mushroom's cap and sifting its spores onto a sheet of white paper. After careful examination, he was able to say that it was only *Lepiota molybdites,* not the nearly indistinguishable *Amanita*—a toxic mushroom often called the "destroying angel." *Lepiota molybdites'* unusual green spores helped Farr identify it as a species which produces stomach upset and nausea but no lasting effect.

Medical emergency identifications like this one are handled about three or four times a year, according to Amy Y. Rossman, research leader for the mycology lab. Rossman, who is also co-curator, says the National Fungus Collections' primary purpose is to provide information about fungi and their hosts to researchers and specialists in the United States and worldwide. The Collections make up the largest fungal herbarium in the world. As many as 10,000 of the nearly 1 million dried specimens are lent out for identification purposes each year.

Not all fungi are harmful. Some beneficial species actually protect plants from disease-causing fungi. Rossman says that using information from the NFC can aid scientists in discovering how to best use these beneficial fungi to protect plants and animals from fungal disease.

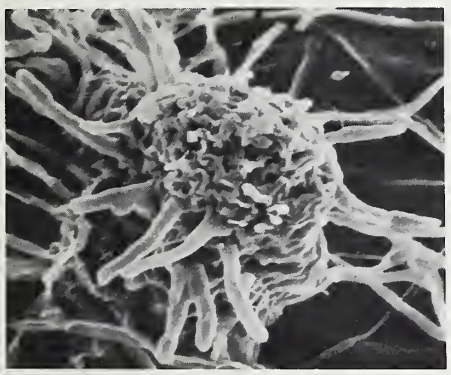
Dried *Amanita* — a deadly mushroom known as the "destroying angel" — is examined by botanist David Farr (left) and technician James Plaskowitz. (0386X491-36)

The mycology lab also serves as a sort of Bureau of Standards for mycologists all over the world. Often, if there is a dispute over the name or other feature of a certain species of fungi, concerned scientists can refer to the type specimen in the NFC to settle the matter.

The NFC fungi are dried for durability and ease of storage. The oldest specimens are preserved in leather-bound books, called exsiccati, dating as far back as the early 1800's. The agency's live fungus collection is housed at the ARS Northern Regional Research Laboratory in

Slime molds in the National Fungus Collection are being tested as possible biocontrol agents against other fungi. (0386X498-20)

In the Stevenson Reference Room, mycologist Amy Rossman studies a rare volume on mushrooms. (0386X494-13)



Magnified 1,050 times, this spider-like fungus called *Uredinophila* occurs naturally on various harmful rusts and may have potential as a biocontrol agent. (Scanning electronmicrograph by James Plaskowitz) (PN-7204)

Peoria, IL, and contains about 33,500 specimens.

Ten to fifteen thousand new specimens are added to the NFC each year. Incoming specimens are frozen to rid them of any pests they may carry. The freezing method is fairly new to the mycology lab—in the past, chemicals such as naphthalene (found in ordinary moth balls) were used for fumigating specimens.

Considerable information about each specimen is stored in the NFC, and until recently there was no easy way to access it. In order to speed handling of requests, a six-person team, headed by Farr, has begun putting the name and description of every specimen into a computer.

This is the first computerized fungus data base in the United States, says Rossman, although not the only one. Scientists at Purdue University's (West Lafayette, IN) Joseph Arthur Herbarium and at the New York Botanical Gardens are following the mycology lab's lead with their own collections.

Computerizing the NFC is expected to take several years, Rossman says. So far, the rusts and smuts have all been entered, along with most of the polypores, or wood-decay fungi. Still to go are over 600,000 specimens in the ascomycetes (such as yeasts, mildews, and truffles), fungi imperfecti, and slime mold groups.

When that job is complete, plans call for entering the lab's fungus-host index—presently on 1.5 million 3- by 5-inch cards. Rossman says the fungus-host index is used to determine the kinds of fungi that grow on a specific plant—jack o'lantern fungus on oak trees, for example. Or, starting with the name of a particular fungus, a user could find out which plants it grows on.

Besides the computerization project, researchers at the mycology lab are revising a 1960 U.S. Department of Agriculture publication, "Index of Plant Diseases in the United States." It is expected to be ready for release in 1988.—By **Caree Lawrence,** ARS.

Amy Y. Rossman and David F. Farr are at the USDA-ARS Systematic Botany, Mycology, and Nematology Laboratory, Room 313, Bldg. 011A, BARC-West, Beltsville, MD 20705. ■

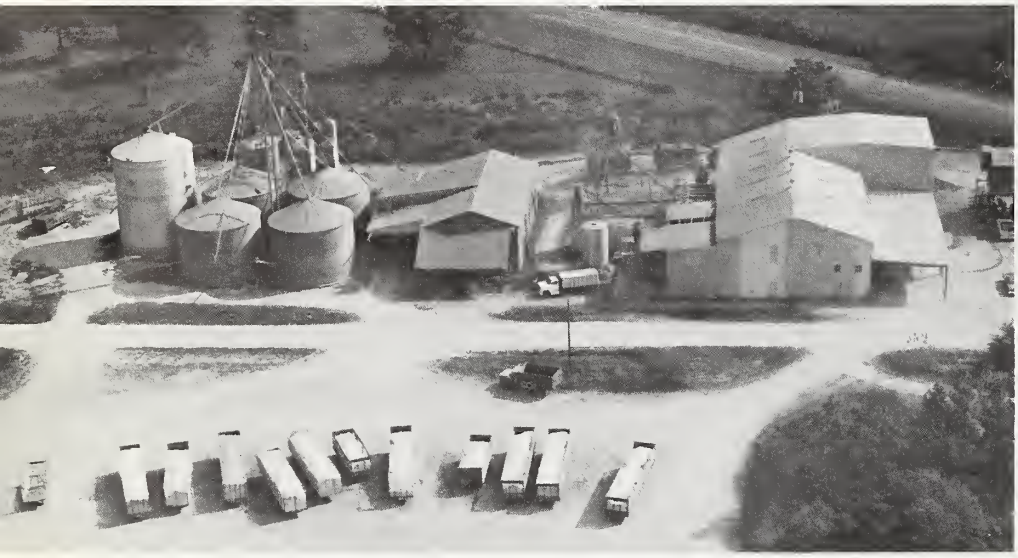
Still Growing, a Century Later

The National Fungus Collections grew out of specimens acquired on government-sponsored expeditions in the 1800's. Officially established in 1869 as the Pathological Collections, the herbarium has grown from some 14,000 specimens in the late 1800's to about 1,000,000 today.

The National Fungus Collections have been supplemented over the years with herbaria from major institutions, including the Smithsonian Institution, the Brooklyn Botanical Garden, the Missouri Botanical Garden, and the Chinese National Herbarium. They also contain the private collections of several famous persons, among them American botanist George Washington Carver, who is better known for his work with peanuts, including the invention of peanut butter.

The Stevenson Reference Room, also part of the mycology lab in Beltsville, houses the personal library of the late John L. Stevenson, a mycologist at USDA for many years. The collection contains about 7,000 books and journals and about 60,000 reprints of articles. The highlight is Stevenson's collection of rare books on the subject of mycology. Many of the volumes date back to the 1700's, and one was published in 1675, enough to make the Stevenson Reference Room the envy of any rare book collector.—C.L. ■

Drying Cotton With Waste Heat



Georgia cotton gin facility. Relocating air intake vents from ground level to near the top of buildings can save money by reusing waste heat. (Photo by Grant Heilman Photography)

Cotton gin managers can save money by reusing waste heat to help dry cotton.

All the managers have to do is relocate air intake vents from the ground level to near the top of buildings where a large pool of hot air collects, according to Agricultural Research Service engineer J. Weldon Laird.

"This simple and inexpensive change will save 15 percent of the overall cost of drying cotton or as much as 75 percent of the cost of second-stage drying. Cotton is dried in two stages, and the second stage sometimes uses cooler air than does the first, which accounts for the greater savings," Laird explains.

This idea came to Laird when he surveyed several cotton gins in Texas to see if the metal gin buildings might serve as solar heat collectors. "Actually," Laird says, he found "the amount of solar heat collected in these buildings is small compared with the amount needed to dry cotton. But a lot of heat builds up from losses from the drying system itself and from motor cooling. Recovering this wasted heat is where the real savings are."

The scientist found that relocating the vents produced additional benefits. It made for cooler, more comfortable conditions for workers. Also, it reduced clogging of intake screens because lint and dust blow about near the floor and do not usually rise to the upper levels of the relocated vents.

Laird did not rearrange machinery in the cotton gin where he performed his experiment. "Better building design and machinery placement would produce more energy savings than we got in our test. Waste heat recovery should be considered in new gin designs," he says.—By **Bennett Carriere,** ARS.

J. Weldon Laird is in USDA-ARS Cotton Production and Engineering Research, Texas A&M University, Route 3, Lubbock, TX 79401. ■

Wind Tunnel Checks Spray Drift

How far can a pesticide be sprayed—sprayed accurately, that is—on a windy day?

Farmers need to know to make sure that pesticide sprays from commonly used airblast systems reach the crops they are aimed at. Sometimes a mere breeze can force the jet-propelled pesticides into near right-angle turns that make them miss their target completely.

"A lot of pesticide chemicals are wasted during spraying operations because of wind," says Robert D. Fox, an Agricultural Research Service engineer in Wooster, OH, who has been studying computer simulations of windblown pesticide sprays as well as watching the real thing in wind tunnel experiments.

"By learning exactly how pesticides get diverted by the wind," he says, "we should be able to develop wind-resistant spraying mechanisms and procedures that could reduce pesticide costs by 30 percent."

Can't farmers simply skip spraying operations on a windy day?

"It doesn't take a strong wind to wreak havoc with a pesticide spray," says Fox.

"Even a mild breeze, at certain angles, can radically alter the direction of conventional airblast sprays," he says.

Fox is particularly concerned about pesticides sprayed from airblast sprayers mounted on tractors or other machines that move through orchards. To reach the tops of the trees, the pesticide has to be sprayed in a high arc that is easily disrupted by the wind.

"We've found that a 15-mi/h crosswind can bend a 120-mi/h spray from that type of equipment as much as 80 degrees," he says. "In fact, with winds from certain directions, the spray can be forced backwards before it gets 6 feet from the nozzle."

Fox and coworkers at the Ohio Agricultural Research and Development Center in Wooster built a 1/12th-size model of a sprayer used in nearby orchards and placed it inside a wind tunnel to measure how

Porkers' Hides Underused for Leather

Making a silk purse out of a sow's ear may be impossible, but a pig's skin can be made into high-quality leather using a method developed by Agricultural Research Service scientists.

William J. Hopkins, a leather chemist with the agency, says simple, inexpensive processes recently developed at the Animal Biomaterials Research Unit in Philadelphia preserve hides in a nearly fresh state for up to 2 weeks until they can be made into leather. They treat pigskins with acid sulfite solutions or sulfur dioxide. The most common way of treating pigskins is with a salt solution, but there are disadvantages to that method.

Salting down, or brining, shrinks pigskins more than other kinds of hides and reduces the quality of the leather that can be made from them.

But the processes developed by Hopkins lessen hide shrinkage and reduce pollution from salt solutions.

Pigskin makes good leather, according to the Pigskin Council of America, which says it is soft but strong, stretches less than cowhide, and easily takes colorful dyes.

Despite the virtues of pigskin, the council estimates that only about 6 percent—fewer than 5 million—of the 80 million hogs slaughtered each year in the United States are skinned for possible leathermaking.

Most of the pigskins are used in food or converted to fat or protein for industrial and agricultural uses, according to Stephen H. Feairheller, who leads the Unit.

Mindful of the failure to capitalize on an abundant hog industry product, agency scientists are seeking ways to make pigskin processing more economically attractive to the industry.

For example, Hopkins wants to develop a stable air-dried hide product that would offer tanneries yet another alternative to salting pigskins. Other researchers have looked at ways to remove excess fat from pigskins so they can be more easily made into leather.

Hopkins is not neglecting the mainstay of the hide industry, either. He has patented a salt-free way to preserve cattlehides. (See *Agricultural Research,* Jan. 1986, p.16.)—By **Sean Adams** and **Linda Anzelmo,** ARS.

William A. Hopkins is at the USDA-ARS Eastern Regional Research Center, 600 Mermaid Lane, Philadelphia, PA 19118. ■

Chemist William Hopkins with treated pigskins. (0186X046-3)

various crosswinds and forward travel speeds affect sprays once they leave the nozzle.

"We have to remember that significant wind problems can arise from movement of the spraying machinery," Fox says as he points to test data which show that an orchard sprayer driven at more than 10 mi/h could lose most of its pesticide to air currents created by the travel of the sprayer itself.

"One solution is to have a sprayer system with nozzles attached to lifting mechanisms that can rise to treetop levels," he says, adding that a prototype of such a system has already been built by ARS engineers.

The wind tunnel tests conducted by Fox enabled him to check and refine a computer program previously developed to simulate how wind affects pesticide sprays.

"For the most part, the computer simulations and our wind tunnel measurements matched up pretty well," says Fox. "At the higher wind velocities, however, the computer tended to underestimate how far the pesticide spray would actually shift. We've now modified the program accordingly."

Fox also used wind tunnel measurements to refine numerical values in the computer program that were based on the flow of air over certain airplane wing designs.

"The arc formed by a high-angle pesticide spray is a lot like a swept-back airplane wing," Fox explains, "and it has some of the same aerodynamic characteristics. Before the wind tunnel tests, aeronautical engineering figures were all we had—but they weren't that far off."

But the wind tunnel data did make the computer program more accurate, says Fox, and that makes it a more reliable engineering tool in the future.

"We can use it with greater confidence," he says, "when designing new pesticide equipment to meet the challenge of a windy day."—By **Steve Miller and Betty Solomon,** ARS.

Robert D. Fox is in USDA-ARS Applied Technology Research at the Ohio Agricultural Research and Development Center, Wooster, OH 44691. ■

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PATENTS

More Effective Lure for Corn Borer Traps

A new insect sex pheromone has been developed to help control the southwestern corn borer (SWCB), a major pest of corn in the southwestern and southeastern United States and Mexico.

The sex attractant pheromone consists of three components which occur naturally in the female SWCB moth. Traps baited with the synthetic pheromone have been shown to lure the male insects as effectively as, and sometimes even more effectively than, traps baited with live females.

Trapping, which is often used in areas where infestations of the insects are known to occur, aids in early detection of the moths and alerts extension specialists, crop consultants, and growers to intensify their sampling for borer egg masses and young larvae within their cornfields.

Before development of the pheromone, the presence of the adults was determined by use of blacklight traps, which require a source of electricity for operation and attract a wide variety of unwanted insects. Moreover, the collections are often damaged by excessive numbers of captured beetles. Thus, the pheromone baited traps are much more effective than blacklight traps.

The synthetic pheromone can also be used to suppress SWCB moth populations by interfering with mating communications and by attracting them to a lethal dose of an insecticide.

For technical information, contact Paul A. Hedin or Frank M. Davis, USDA-ARS Crop Science Research Laboratory, P.O. Box 5367, Mississippi State, MS 39762. *Patent Application Serial No. 785,639, "Sex Pheromone Composition for Southwestern Corn Borer."* ■

Artificial Pheromones

The pheromone for the spined soldier bug referred to in "New Chemical Bait Lures Yellowjackets Into Traps," page 11, is Patent Application Serial No. 681,394, *"Synthetic Pheromones for the Spined Soldier Bug,* Podisus maculiventris." See also Oct. 1984, p. 11. ■

Improved Seed Planter

The punch planter, a device used to plant seeds without excessively disturbing the soil, now has a variable rate seeding feature that may make its use more widespread.

In punch planting, uniformly spaced plungers around a wheel penetrate the soil surface. Until now, the inability to change seeding rates limited its use to a few crops or planting situations.

But the new invention replaces the conventional punch wheel with a crank wheel and a pivoting punch column. By adjusting the pivot points of the column and the gear ratio between the crank wheel and a timing wheel the seeding rate can be varied.

The punch planter can be instrumental in reducing soil erosion, because it plants seeds without disturbing residue on the soil surface, which forms a protective cover against wind and rain.

For technical information, contact Maurice R. Gebhardt, USDA-ARS, Building T-12, University of Missouri, Columbia, MO 65211. *Patent Application Serial No. 759,385, "Punch Planter for Variable Seed Spacing."* ■

How To Obtain a License for USDA Patents

A listing of all U.S. Department of Agriculture patents is available on request. If you are interested in applying for a license on a patent or receiving the catalog, write to the Coordinator, National Patent Program, USDA-ARS, Rm. 401, Bldg. 005, Beltsville, MD 20705.

Copies of existing patents may be purchased from the Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, Washington, DC 20231. Copies of pending patents may be purchased from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. ■

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